

Drawings

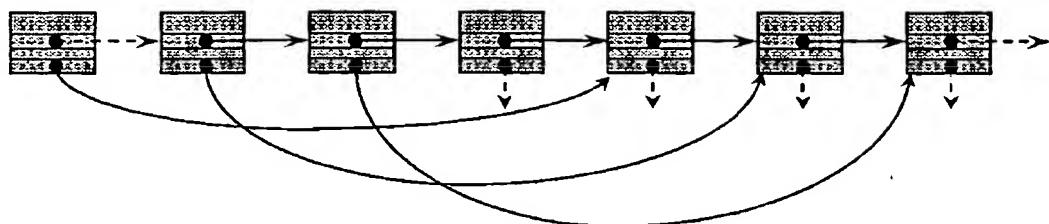


Figure 1: Linked list representation with jump pointers (Prior Art).

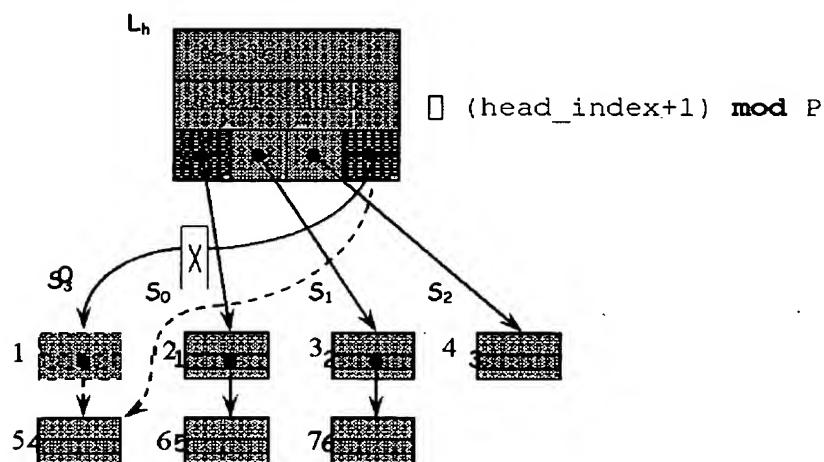


Figure 2: A prefetchable linked list representation.

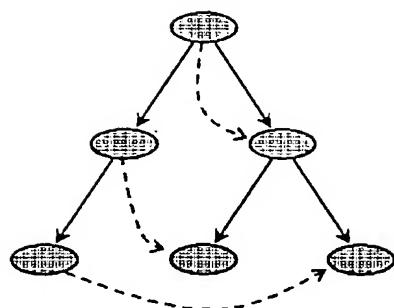


Figure 3: A tree data structure with history pointers (Prior Art).

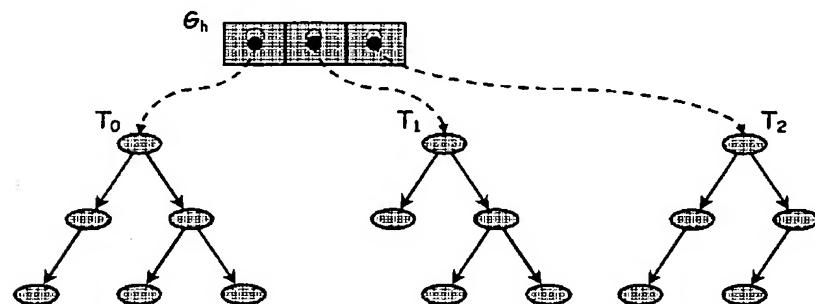


Figure 4: A prefetchable tree representation.

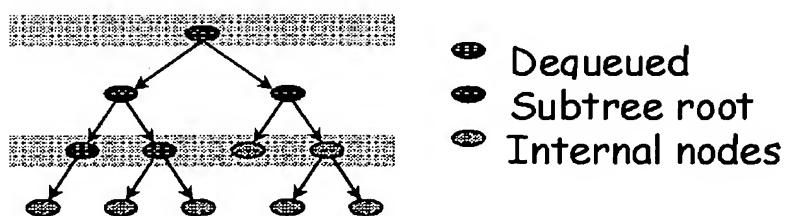


Figure 5: Transforming a Tree into a Forest.

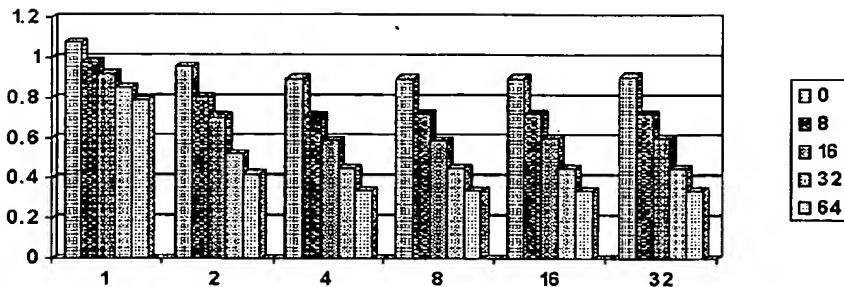


Figure 6: Performance of prefetched linked list traversals.

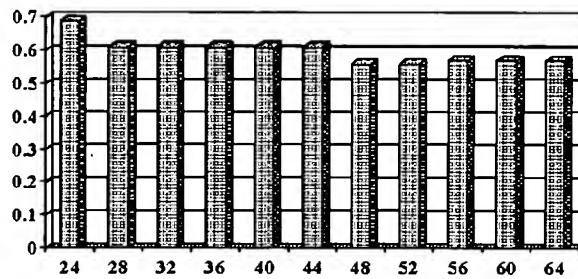


Figure 7: Performance of prefetched tree traversals.

```
list_element_ptr process_list( list_ptr list )
{
    int i, p;
    list_element_ptr s[PipeDepth];

    /* prologue */
    p = list->headers;
    for ( i=0, i<p; i++ ) {
        PREFETCH( s[i] = list->head[i] );
    }

    /* steady state */
    while ( p ) {
        for ( i=0; i<p; i++ ) {
            if ( process_element( s[i] ) == STOP )
                return s[i];
            s[i] = s[i]->next;
            PREFETCH( s[i] );
        }
    }
}
```

Figure 8: Example of a Pipelined Linked List traversal.

```
Traverse( forest_ptr forest )
{
    /* local variables */
    stack stacks[PipeDepth]; /* PipeDepth stacks */
    tree_ptr n;
    int i, trees_left = PipeDepth;
    struct {
        tree_ptr node;
        stack_ptr stack;
    } traversal[PipeDepth]; /* traversal state descriptor */

    /* prologue */
    for ( i=0; i<PipeDepth; i++ ) {
        traversal[i].node = forest->root[i];
        traversal[i].stack = &stack[i];
        PREFETCH(forest->root[i], sizeof(forest->root[i]));
    }

    /* steady state */
    while ( trees_left ) {
        for ( i=0; i<trees_left; i++ ) {
            if ( traversal[i].node->left ) {
                traversal[i].stack->push( traversal[i].node->left );
                traversal[i].node = traversal[i].node->left;
            } else {
                n = traversal[i].stack->pop();
                if ( n == NULL ) { /* done with tree i */
                    trees_left--;
                    if ( i != trees_left )
                        SWAP( &traversal[i], &traversal[trees_left] );
                }
                process( n );
                traversal[i].node = n->right;
            }
            PREFETCH( traversal[i].node );
        }
    }
}
```

Figure 9: Example of a Pipelined Tree Traversal.

```
Traverse( tree_ptr tree )
{
    /* local variables */
    . . .

    /* level-order traversal prologue */
    PREFETCH( tree->root );
    enqueue( src_queue, tree->root );
    for ( i=0, accumulating=true; accumulating; i++ ) {
        n = dequeue(src_queue);
        if ( n == NULL )
            return;                  /* we're done */
        process(n->data);

        if ( n->left != NULL ) {
            PREFETCH( n->left );
            enqueue( dst_queue, n->left );
        }
        if ( n->right != NULL ) {
            PREFETCH( n->right );
            enqueue( dst_queue, n->right );
        }
        if ( src_queue->size + dst_queue->size < PipeDepth ) {
            if ( i >= src_queue->size )
                SWAP( src_queue, dst_queue );
            else {
                accumulating = false;
                while ( src_queue->size > 0 ) {
                    traversal[trees_left].node = dequeue( src_queue );
                    traversal[trees_left].stack = stack[trees_left];
                    trees_left++;
                }
                while ( dst_queue->size > 0 ) {
                    traversal[trees_left].node = dequeue( dst_queue );
                    traversal[trees_left].stack = stack[trees_left];
                    trees_left++;
                }
            }
        }
    }
    /* steady state loop */
    . . .
}
```

*Figure 10: Example of a pipelined level-order tree traversal.*